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INCASTING FOR DOWNLOADING  
FILES ON DISTRIBUTED NETWORKS

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1 BACKGROUND OF THE INVENTION

2       The present invention relates to a data storage/access  
3 in a client-server system which consists of a plurality of  
4 hosts each of which may act as either a server or clients  
5 and which are interconnected by a shared communication  
6 channel.

7       Research and development have been achieved on a  
8 server with a storage device for storing a number of files,  
9 such as a movie. The server distributes these files upon a  
10 demand from a client.

11       A video server system needs extension due to lack of  
12 capacity of server computers, it has been solved by  
13 replacing the old ones with a higher performance server  
14 computer, or by increasing the number of server computers

1 so that a load of processing is distributed over a  
2 plurality of server-computers. The latter way of extending  
3 the system by increasing the number of server computers is  
4 effective in terms of workload and cost. A video server as  
5 such is introduced in "A Tiger of Microsoft, United States,  
6 Video on Demand" in an extra volume of Nikkei  
7 Electronics titled "Technology which underlies Information  
8 Superhighway in the United States", pages 40, 41 published  
9 in Oct. 24, 1994 by Nikkei BP.

10 A server system includes a network and server-  
11 computers. The server-computers are connected to the  
12 network and have a function as a video server, magnetic  
13 disk unit which are connected to the server computers and  
14 stores video programs, clients which are connected to the  
15 network and demand the server computers to read out a video  
16 program. Each server computer has a different plurality of  
17 set of video programs such as a movie stored in the

1 magnetic disk units. A client therefore reads out a video  
2 program via one of the server-computers which has a  
3 magnetic disk units where a necessary video program is  
4 stored. The server system in which each one of a plurality  
5 of server-computers stores an independent set of video  
6 programs. The server system is utilized efficiently when  
7 each demand on a video program is distributed to different  
8 server computers. However when a plurality of accesses  
9 rush into a certain video program, a work load increases on  
10 a server computer where this video program is stored,  
11 namely a work load disparity will be caused among server  
12 computers. Even if the other server computers remain idle,  
13 the whole capacity of the system has reached to the utmost  
14 level because of the overload on a capacity of a single  
15 computer. This deteriorates the efficiency of the server  
16 system.

17 U. S. Patent No. 5,630,007 teaches a client-server

1 system which includes a plurality of servers and a  
2 plurality of storage devices. The storage devices  
3 sequentially store data. The data is distributed in each  
4 of the plurality of storage devices. Each server device is  
5 connected to the plurality of storage devices for accessing  
6 the data distributed and stored in each of the plurality of  
7 storage devices. The client-server system improves  
8 efficiency of each server by distributing loads to a  
9 plurality of servers. The client-server system also  
10 includes an administration apparatus. The administration  
11 apparatus is connected to the plurality of servers for  
12 administrating the data sequentially stored in the  
13 plurality of storage devices and the plurality of servers.  
14 A client is connected to both the administration apparatus  
15 and the plurality of servers. The client specifies a  
16 server that is connected to a storage device where a head  
17 block of the data is stored by inquiring to the

1 administration apparatus and accesses the data in the  
2 plurality of servers according to the order of the data  
3 storage sequence from the specified server. The client  
4 makes an inquiry to the administration apparatus and  
5 accesses the data in the plurality of servers in accordance  
6 to the order of the data storage sequence from the  
7 specified server.

8 U. S. Patent No. 5,905,847 teaches a client-server  
9 system which improves efficiency of each server by  
10 distributing loads to a plurality of servers having a  
11 plurality of storage devices. The storage devices  
12 sequentially store data. The data is distributed in each  
13 of the plurality of storage devices. Each server is  
14 connected to the plurality of storage devices for accessing  
15 the data distributed and stored in each of the plurality of  
16 storage devices. An administration apparatus is connected  
17 to the plurality of servers for administrating the data

1 sequentially stored in the plurality of storage devices and  
2 the plurality of servers. A client is connected to both  
3 the administration apparatus and the plurality of servers.  
4 The client specifies a server which is connected to a  
5 storage device in which a head block of the data is stored  
6 by making an inquiry to the administration apparatus and  
7 accesses the data in the plurality of servers in accordance  
8 to the order of the data storage sequence from the  
9 specified server.

10 U. S. Patent No. 5,926,101 teaches a multi-hop  
11 broadcast network of nodes which have a minimum of hardware  
12 resources, such as memory and processing power. The  
13 network is configured by gathering information concerning  
14 which nodes can communicate with each other using flooding  
15 with hop counts and parent routing protocols. A  
16 partitioned spanning tree is created and node addresses are  
17 assigned so that the address of a child node includes as

1 its most significant bits the address of its parent. This  
2 allows the address of the node to be used to determine if  
3 the node is to process or resend the packet so that the  
4 node can make complete packet routing decisions using only  
5 its own address.

6 U. S. Patent No. 6,108,703 teaches a network-  
7 architecture which has a framework. The framework supports  
8 hosting and content distribution on a truly global scale.  
9 The framework allows a content provider to replicate and  
10 serve its most popular content at an unlimited number of  
11 points throughout the world. The framework includes a set  
12 of servers operating in a distributed manner. The actual  
13 content to be served is preferably supported on a set of  
14 hosting servers (sometimes referred to as ghost servers).  
15 This content includes HTML page objects that are served  
16 from a content provider site. A base HTML document portion  
17 of a Web page is served from the content provider's site





1 transfers data portions of files from the client device to  
2 the storage element.

3 U. S. Patent No. 5,802,301 teaches a method for  
4 improving load balancing in a file server. The method  
5 includes the steps of determining the existence of an  
6 overload condition on a storage device having a plurality  
7 of retrieval streams, accessing at least one file thereon,  
8 selecting a first retrieval stream reading a file,  
9 replicating a portion of the file being read by the first  
10 retrieval stream onto a second storage device and reading  
11 the replicated portion of the file on the second storage  
12 device with a retrieval stream capable of accessing the  
13 replicated portion of the file. The method enables the  
14 dynamic replication of data objects to respond to  
15 fluctuating user demand. The method is particularly useful  
16 in file servers such as multimedia servers delivering  
17 continuously in real time large multimedia files such as

1 movies.

2 U. S. Patent No. 5,542,087 teaches a data processing  
3 method which generate a correct memory address from a  
4 character or digit string such as a record key value and  
5 which is adapted for use in distributed or parallel  
6 processing architectures such as computer networks,  
7 multiprocessing systems, and the like. The data processing  
8 method provides a plurality of client data processors and a  
9 plurality of file servers. Each server includes at least a  
10 respective one memory location or "bucket". The data  
11 processing method includes the steps of generating a key  
12 value by means of any one of the client data processors and  
13 generating a first memory address from the key value. The  
14 first address identifies a first memory location. The data  
15 processing method also includes the steps of selecting  
16 from the plurality of servers a server that includes the  
17 first memory location, transmitting the key value from the

1 one client to the server that includes the first memory  
2 location and determining whether the first address is the  
3 correct address by means of the server. The data  
4 processing method further provides that if the first  
5 address is not the correct address then performing the  
6 steps of generating a second memory address from the key  
7 value by means of the server, the second address  
8 identifying a second memory location, selecting from the  
9 plurality of servers another server which includes the  
10 second memory location, transmitting the key value from the  
11 server that includes the first memory location to the other  
12 server which includes the second memory location,  
13 determining whether the second address is the correct  
14 address by means of the other server and generating a third  
15 memory address, which is the correct address, if neither  
16 the first or second addresses is the correct address. The  
17 data processing method provides fast storage and subsequent

1 searching and retrieval of data records in data processing  
2 applications such as database applications.

3 Distributed storage and sharing of data and program  
4 files has become an integral part of doing business over  
5 the Internet and other distributed networks. Such a  
6 distributed environment is characterized by the fact that  
7 multiple copies of the same file reside over the network.

8 In peer-to-peer networking each user also doubles as a  
9 server connected to the Internet. Service providers, such  
10 as Napster, Gnutella and Freenet have emerged. This  
11 emerging technology has the potential to revolutionize  
12 Internet and E-Commerce, but several technological  
13 challenges have to be overcome before it can be translated  
14 into a robust product which hundreds of millions of  
15 customers can reliably use.

16 The most frequent use of such a network is for  
17 downloading purposes. A client looks up the content list,

1 and wants to download a particular file/content from the  
 2 network. The existing protocols for this process are  
 3 extremely simple and can be described in general as  
 4 follows. The client or a central server searches the list  
 5 of servers that contain the desired file, and picks one  
 6 such server (either randomly or according to some priority  
 7 list maintained by the central server) and establishes a  
 8 direct connection between the client requesting the down  
 9 load and the chosen server. This connection is maintained  
 10 until the entire file has been transferred. The exact  
 11 implementation might vary from one protocol to another;  
 12 however, the fact that only one server is picked for the  
 13 transfer of the entire requested file remains invariant.

14       The above-mentioned existing protocols suffer from  
 15 several serious drawbacks, as stated next. Since only one  
 16 server is picked for the transfer of the entire file (even  
 17 though there are potentially many servers with the same

1 content), the quality of service becomes totally dependent  
2 on the bandwidth and the reliability of the Internet access  
3 that the chosen server maintains during the transfer. This  
4 poses a serious problem, especially in the case of networks  
5 that primarily comprise of low-performance servers as is  
6 the case for Napster and other proposed peer-to-peer  
7 networks and the reliability and speed of the host  
8 computers cannot be guaranteed. The average available  
9 bandwidth could be as low as that of a 28.8K or a 56K  
10 modem. Moreover, the connection of the server to the  
11 Internet could be dropped in the middle of a download,  
12 necessitating another attempt from the beginning. For  
13 example, an average MP3 file is around 5 Mega-bytes in  
14 length, and it will take around 16-20 minutes to download  
15 it over a 56K modem!! If the connection is dropped at any  
16 time during this period, then one needs to attempt the  
17 download all over again. The issue of choosing the best

1 server among those that have a copy of the requested file  
2 is not properly addressed, leading to a further loss in the  
3 quality of the service. If the winner is picked randomly  
4 then clearly it is not the best choice. Even if the winner  
5 is picked based on a pre-sorted list, where servers are  
6 ranked according to their average available bandwidth, the  
7 resulting scheme would be far from optimal. In particular,  
8 even if a server has a higher average bandwidth, since it  
9 comprises only a part of the host computer and shares the  
10 bandwidth with other competing tasks, the available  
11 bandwidth for the download could be drastically low during  
12 the time of the transfer. The protocols do not take  
13 advantage of the fact that the client could have a much  
14 higher available bandwidth than any of the potential  
15 servers. For example, even if the client is connected to a  
16 high-speed Ethernet, the effective transfer rate for the  
17 session could still be as low as that of a modem that the







1        Fig. 5 is a schematic drawing of a file format for use  
2        in the distributed network of Fig. 4.

3        Fig. 6 is a schematic drawing of an entry for a file  
4        in a global list in which the entry contains all the  
5        necessary information about the file so that a client can  
6        successfully complete an incasting process using the  
7        distributed network of Fig. 4.

8        DESCRIPTION OF THE PREFERRED EMBODIMENT

9        Fig. 1 is a video server system of the prior art  
10       includes a network 1 and server computers 2. The server  
11       computers 2 are connected to the network 1 and have a  
12       function as a video server, magnetic disk unit 3 which are  
13       connected to the server computers 2 and stores video  
14       programs, clients 5 which are connected to the network 1  
15       and demand the server computers 2 to read out a video  
16       program. Each server computer 2 has a different plurality  
17       of set of video programs such as a movie stored in the

1 magnetic disk units 3. A client 5 therefore reads out a  
2 video program via one of the server computers 2 which has a  
3 magnetic disk units 3 where a necessary video program is  
4 stored.

5 Referring to Fig. 2 in conjunction with Fig. 3 a video  
6 server system 10 of U. S. Patent No. 5,630,007 includes a  
7 network 11, such as Ethernet and ATM, and a plurality of  
8 server computers 12. Application programs are connected to  
9 the network 11. Magnetic disk units 31 and 32 are  
10 connected to the server computers which sequentially store  
11 distributed data, such as a video program, which has been  
12 divided (referred to as "striping") to be stored in the  
13 magnetic disk units 31 and 32, client computers 5 which are  
14 connected to the network 1 and receive video program,  
15 application programs which operate in the client computers  
16 5, driver programs as an access demand means which demand  
17 access to the video program 4 having been divided and

1 sequentially stored in magnetic disk units 31 and 32 in  
2 response to a demand to access from application programs.  
3 Client-side network interfaces carry out such process as  
4 TCP/IP protocol in the client computers 5 and realize  
5 interfaces between clients and the network 1, server-side  
6 network interfaces which carry out such processes as TCP/IP  
7 protocol in the server computers 2 and realizes interface  
8 between servers and the network 1, server programs which  
9 read data block out of magnetic disk units 31 and 32 to  
10 supply it to the server-side network interfaces the  
11 original video program 11 which has not yet been divided  
12 nor stored, administration computer 12 connected to the  
13 network 1, administration program 13 operated in the  
14 administration computer 12 which administrates the video  
15 program having been divided and stored in magnetic disk  
16 units 31 and 32 and the server computers 2. The  
17 administration computer-side network interface carries out

1 such process as TCP/IP protocol in the administration  
2 computer 12 and realizes an interface between the  
3 administration computer 12 and the network 1, and a large  
4 capacity storage 15 such as CD-ROM, which is connected to  
5 the computer 12 and the original video program 11 is stored  
6 therein.

7 Still referring to Fig. 2 only two magnetic disk units  
8 are connected to each server computer. Each of the three  
9 server computers 2 is connected to two magnetic disk units,  
10 respectively, and also connected to the administration  
11 computer 12 and a plurality of client computers 5 which are  
12 devices on the video-receiving side, via the network 1.  
13 Each magnetic disk unit 31 or 32 is divided into block  
14 units per a certain amount. Six video programs, denoted by  
15 videos 1~6 are stored in 78 blocks denoted by blocks 0~77.  
16 Each video program is stored as if data was striped where  
17 data has been divided and distributed over the plurality of

1 the magnetic disk units 31 and 32. Video 1 is sequentially  
2 stored in the blocks 0~11, and video 2 is sequentially  
3 stored in the blocks 12~26. Videos 3~6 are also stored in  
4 the blocks, respectively.

5 Referring to Fig. 4 a distributed network 110 includes  
6 a plurality of hosts 111 and a shared communication channel  
7 112. Each host is coupled to the shared communication  
8 channel 112. Each host 111 may act as both a client and a  
9 server and uses the distributed network 110, but not all of  
10 the hosts need to act as either a client or a server. The  
11 downloading process may be called incasting because it can  
12 be construed as a reverse of broadcasting. In  
13 broadcasting, a file 120 is transmitted to multiple  
14 locations generating multiple copies of the file 120. In  
15 contrast, in incasting fragments 121 of multiple copies of  
16 the file 120 are gathered together to generate a single  
17 copy of the file 120. There is a format for creating and

1 storing multiple copies of the files 120 and a protocol to  
2 guarantee fast in the sense that it utilizes the maximum  
3 available bandwidth for the task and accurate transfer of  
4 the requested content/file 120 to a client in the sense  
5 that the content of the copied file 120 is the same as that  
6 of the stored one. Incasting would constitute the backbone  
7 of the distributed network 110.

8 Incasting addresses a key technological issue of how  
9 to provide a high-quality service in terms of both accuracy  
10 and speed for transferring a file 120, which a client has  
11 requested, to the client on the distributed network 110  
12 that support content replication. The same content or file  
13 120 can reside in several different servers on the  
14 distributed network 110. This could be either because the  
15 file 120 was created at only one server and then  
16 distributed to several others or because the same content  
17 was created or procured independently at different servers.

1       Incasting will work even if no individual server has  
2   the complete file 120, but as long as the complete file 120  
3   is collectively available on the whole distributed network  
4   110. There is a unique identification tag for each content  
5   or file 120 residing on the network. A list of all  
6   accessible content/files 120 is either available from one  
7   central server or is maintained in a distributed manner.  
8   Several servers may contain a complete or partial lists of  
9   the contents. Such a list would contain the identification  
10   tags of all the contents. For each content/file 120 it  
11   would list all the servers that contain a copy of the file  
12   120.

13       Referring to Fig. 5 the file 120 is divided into a  
14   number of segments 121. Each segment 121 has a secure hash  
15   function. The secure hash function is used to compute a  
16   message digest, which is then signed. The number of  
17   segments 121, their locations, the hash function(s) and the



1 public key(s) for the digital signatures are recorded as  
2 attributes of the file 120.

3       The incasting process will work for any existing  
4 format for storing files 120 which follows the convention  
5 of being byte aligned. Hence, any server can handle a  
6 request, where it is asked to transmit blocks of bytes  
7 along with start and end indices. For example, a typical  
8 request could be for the transmission of M bytes of a file  
9 120 starting at the kth byte. However, for guaranteeing  
10 the integrity of the files 120 and for avoiding expensive  
11 retransmissions of potentially erroneous downloads, the  
12 following format for storing files 120 and partitioning the  
13 file 120 into a specified number of segments 121 is  
14 recommended. For each segment 121, compute a message  
15 digest of the contents using a secure hash function. The  
16 message digest basically acts as a unique identifier for  
17 the contents of the segment 121 and on reception, can be

1 used to guarantee the integrity of the contents of the  
2 segment 121. In order to guarantee authenticity (e.g., the  
3 fact that the file 120 was indeed created by the owner),  
4 one can in addition sign the digest. Thus, if one has the  
5 segment 121, the message digest and the digital signature  
6 of the file 120, then one can verify authenticity (check  
7 that the signature matches the digest) and then check for  
8 integrity (i.e., the digest matches the contents of the  
9 segment 21). For example, the Secure Hash Standard (SHS)  
10 can be used to generate 160-bit message digests for the  
11 segments 121. The Digital Signature Standard (DSS) can  
12 then be used to generate a 320-bit digital signature of the  
13 digest. Other standard hash functions (e.g., MD4 and MD5)  
14 and digital signature schemes (e.g., those based on RSA)  
15 can be used as well. The number of segments 21 and their  
16 starting locations can be stored in the file description.  
17 Moreover, if the feature of digital signature is used, then

1 the public key(s) of the owner of the file 20 and the hash  
2 function used should also be made available in the  
3 description of the files 120.

4 Referring to Fig. 6 each entry for a file 120 in a  
5 global list 130 contains all the necessary information  
6 about the file 120 so that a client can successfully  
7 complete an incasting process. The client wishing to  
8 download a file 120 goes through the following step of  
9 searching the distributed network 110. The client first  
10 searches the global list(s) 130 of content/files 120 (to be  
11 referred to as the network directory from hereon) to  
12 determine the availability of the desired file 120 on the  
13 distributed network 110. It is not necessary that a global  
14 network directory be maintained at one or several servers.  
15 The network directory could itself be maintained in a  
16 distributed fashion (e.g., the scheme adopted in the  
17 Gnutella network) in which case, a distributed search for

1 the desired content/file 120 will be carried out. In both  
2 cases, the following information is returned to the client.  
3 A list of (IP) addresses for the servers where the file 120  
4 is located partially or in full. If a server has only  
5 parts of the desired file 120, then a succinct description  
6 (e.g., start and end byte numbers of contiguous portions of  
7 the file 120) of the content stored in the server is also  
8 included. If the file 120 is divided into segments 21  
9 along with corresponding digest and digital signature, then  
10 the client will also receive descriptions of the segments  
11 21, and the types of hash functions and public key(s) used  
12 for the digital signature. The client now has all the  
13 storage information about the desired file 20, but does not  
14 know the exact availability of bandwidth at the eligible  
15 servers for any download request. Using an adaptive  
16 incasting algorithm the client is able to virtually  
17 segments the file 120 into a number of distinct parts and

1 requests each part from a distinct server. The exact  
2 nature of the virtual segmentation procedure will depend on  
3 a number of factors, including, the bandwidth available to  
4 the client, any prior knowledge about the bandwidth  
5 available to different servers and also the storage format  
6 of the requested file 120. Since, these are all very  
7 implementation-dependent, specific details of the virtual  
8 segmentation procedure are not provided. Different servers  
9 will respond at different time intervals to the above-  
10 mentioned requests. For example, the servers that have  
11 high available bandwidth will respond faster than those  
12 with slower access, and some servers might not respond at  
13 all. The client can then have an online estimate of the  
14 traffic and can change the frequency and size of the  
15 requests adaptively. Some servers that do not respond  
16 during a pre-specified time interval could be dropped from the  
17 list altogether or could be tried again after an interval

1 of time, if the other active servers are not fast enough.  
2 This scheme allows complete flexibility and can be used to  
3 saturate the available bandwidth of the client. As the  
4 above-mentioned adaptive protocol is carried out, the  
5 desired file 20 is received in contiguous chunks of bytes.  
6 Since the segmentation format of the file 120 is known to  
7 the client, it can always check whether any complete  
8 segment 21 of the file 120 has been downloaded or not.  
9 Once a full segment 121 of the file 120 is downloaded, it  
10 can first verify authenticity of the message digest using  
11 the digital signature and the public key and then verify  
12 the accuracy/integrity of the segment 121 by comparing the  
13 downloaded message digest with a digest that it computes on  
14 the content of the segment 121 (using a pre-specified hash  
15 function). If any of these verification procedures fails,  
16 then it discards the whole segment 121 and starts the  
17 requests for the bytes in that segment 121 again. Clearly,

1 there is a tradeoff here between the number of original  
2 segments 121 in the file 120 and the number of bytes that  
3 might be downloaded multiple times. If there are more  
4 segments 121 in the file 120, then first the chance that a  
5 segment 121 is corrupted is small, and second even if some  
6 bytes are corrupted then only a small number of bytes will  
7 need to be downloaded again. However, more segments 121  
8 would mean a larger overhead in terms of the total size of  
9 the file 120. For example, if the Digital Signature  
10 Standard is used, then each segment 121 has to have at  
11 least an additional 60 bytes: 160 bits (20 bytes) for the  
12 message digest and 320 bits (40 bytes) for the digital  
13 signature.

14       Incasting allows a client to efficiently download a  
15 file 120 from the distributed network 110 by putting  
16 together fragments of the file 120 obtained from different  
17 servers that maintain partial or complete copies of the

1 desired file 120. While the well-known broadcasting  
2 procedure creates copies of the same file 120 at many  
3 different destination servers incasting recreates a copy of  
4 the file 120 by optimally piecing together fragments of the  
5 file 120 obtained from multiple target servers. Incasting  
6 provides both a suitable format for storing the files 120  
7 and a protocol for gathering the distributed content to  
8 create an accurate copy. The same content/file 120 can  
9 reside in several different servers on the distributed  
10 network 110. This could be either because, the file 120  
11 was created at only one server, and then distributed to  
12 several others, or because the same content was created or  
13 procured independently at different servers. In fact, our  
14 invention will work even if no individual server has the  
15 complete file 120, but as long as the complete file 120 is  
16 collectively available on the whole distributed network  
17 110. There is a unique identification tag for each content



1 or file 120 residing on the network. A list of all  
2 accessible content/files 120 is either available from one  
3 central server, or is maintained in a distributed manner  
4 (i.e., several servers contain the complete or partial  
5 lists of the contents). Such a list would contain the  
6 identification tags of all the contents, and for each  
7 content/file 120 it would list all the servers that contain  
8 a copy of the file 120.

9 The most frequent use of the distributed network 10 is  
10 for downloading purposes. A client looks up the content  
11 list, and wants to download a particular content/file 20  
12 from the distributed network 10. The existing protocols  
13 for this process are extremely simple, and can be described  
14 in general as follows. The client or a central server  
15 searches the list of servers that contain the desired file  
16 20 and picks one such server (either randomly or according  
17 to some priority list maintained by the central server) and

1 establishes a direct connection between the client  
2 requesting the down load and the chosen server. This  
3 connection is maintained until the entire file 20 has been  
4 transferred. The exact implementation might vary from one  
5 protocol to another; however, the fact that only one server  
6 is picked for the transfer of the entire requested file 120  
7 remains invariant.

8       The distributed network includes a plurality of hosts  
9 and a shared communication channel. Each host has a  
10 storage device. U. S. Patent No. 5,630,007 teaches a  
11 distributed network which includes a plurality of servers  
12 with storage devices and a plurality of clients. In U. S.  
13 Patent No. 5,630,007 the servers are distinct from the  
14 clients. In this invention the clients and the servers are  
15 interchangeable. Each host may act as either a client or a  
16 server. A file is divided into a plurality of segments.  
17 Each segment is transmitted to the storage devices of

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1 several of the hosts and stored in the storage device of  
2 the host. Each host is coupled to the shared communication  
3 channel. A host acting as a client requests that the other  
4 hosts acting as servers and collectively send all of the  
5 segments to the requesting client so that the requesting  
6 client can gather the segments together in order for the  
7 segments to self-assemble and generate a single copy of the  
8 file. At least one host has a global list with entries.  
9 Each entry contains all the necessary information about the  
10 file.

11 From the foregoing it can be seen that incasting for  
12 downloading files 120 on distributed networks 110 has been  
13 described.

14 Accordingly it is intended that the foregoing  
15 disclosure and drawings shall be considered only as an  
16 illustration of the principle of the present invention.